

AUG 21 2018

EXCERPT FROM KNOWLTON FARM'S 2017 AG-ENERGY GRANT APPLICATION TO MDAR**PLANNING BOARD
GRAFTON, MA**

The PV-array for the project is designed to accommodate a range of crop types both within the rows and along the edges of the array footprint. The proposed crop types fall into five categories (listed in Figure 1), with four being paired with additional and separate control test-plot against which crop yields, inputs, and other farming metrics can be compared. The Project is designed to accommodate a seven-foot wide tractor and tiller between the rows (at minimum), and will leverage PV-racking architecture to provide water (e.g. via gutters and a rain-barrel system), vertical-growing opportunities (e.g. via trellises and hanging pouches), and specialized crops not otherwise possible on a standard farm plot (e.g. Shade-Tolerant crops under the panels and behind the hanging pouches, such as ferns and mushrooms). The Project will also accommodate Sun-Loving crop types between the rows to better understand what can be effectively cultivated over a larger land area.

Figure 1: Crop Categories

| CATEGORY | CROPS | CONTROL PLOT |
|--|---|--------------------------------|
| Sun-Loving Crops | Strawberries, asparagus, tomatoes, huskcherries, peppers, potatoes, sweet potatoes, squash, pumpkins, cucumbers, zucchini, eggplant, broccoli, cauliflower, brussel sprouts, carrots, beets, beans, basil, melons, onions, cabbage, sweet corn, collard greens, sunchokes | Yes |
| Shade-Tolerant Crops | Salad greens, lettuce, spinach, bok choy, pak choi, arugula, mesclun, mizuna, Asian greens, kale, swiss chard, mustard greens, currants, gooseberries, leeks, jostaberries | Yes |
| Hugelkulture Crops (i.e. grown in log mounds) | Shitake mushrooms, morel mushrooms, wild leeks and ramps, wild ginger, ostrich ferns (aka fiddlehead ferns) | Yes |
| Vertically-Grown Crops | Pea-trellises, herbs, greens, wildflowers, pollinator attracting vines, groundnut, others listed above | Yes |
| Wildflower Honey | Perennial and annual (native) wildflowers: milkweeds, asters, lupine, purple coneflower, bee balm / wild bergamot, mountain mint flower, beardtongue, clovers | No, Located Adjacent to Arrays |

We are confident in the marketability of the produce grown as part of this project and will partner with a wholesale distributor of local, organic food in Massachusetts (e.g. such as Lettuce Be Local) to purchase the farming output. Not only will our efforts enable a comprehensive look at the economics of Co-Location for Knowlton Farms, it will also help prove that markets exist specifically for produce grown from Co-Located projects. We believe there will be marketing advantages for products grown in this fashion and intend to capture that advantage.

OVERALL PROJECT OBJECTIVES

Strengthen University-Research on Dual-Use— Support university research that evaluates the viability of Dual-Use as a business model under solar PV-system designs and planting regimes common to the New England region. Supported by Knowlton Farms and BlueWave, and in partnership with the University of Massachusetts Amherst Stockbridge School of Agriculture, the proposed university

partnership will provide (i) opportunities for academic advising and research methodology development on Dual-Use that will guide Project implementation and on-going monitoring, student-theses, and related university research, and (ii) opportunities to augment research on existing university-sponsored Dual-Use projects.

Prove Viability - Demonstrate that agricultural crop cultivation (specifically food crops) and solar PV energy production can occur simultaneously in ways that (i) incentivize profitable farming and new entrants into the MA agricultural industry, (ii) maximize crop diversification; (iii) prove the viability of crops specific to Massachusetts, (iv) minimize farm land impacts, (v) preserve solar PV-system productivity, and (vi) prove solar design and agricultural concepts applicable to small-, medium-, and large-scale Co-Location projects.

Integrate Agricultural Planning into Solar PV Development - (i) Evaluate the range of crop types that can be grown in distinct zones identified within a PV-array footprint, including Full-shade (under the panels), Partial-shade (i.e. between the panels), and No-shade (i.e. between and around the panels); (ii) Demonstrate solar PV geometries that enable sunlight profiles appropriate for New England growing seasons; (iii) Identify agriculturally-sensitive design, installation, and O&M methods suitable for ground-mounted solar-PV projects; (iv) Provide electricity for year-round growing operations next to the PV-array via a proposed greenhouse; and (iv) Promote biodiversity by investigating ecological enhancement opportunities such as pollinator gardens that can support apiary operations, permaculture, and other localized benefits.

Create Customized PV-Designs to Enhance Farming Practice – Collaborate with BlueWave Solar and RBI Solar to explore (i) how ground-mounted PV racking design can provide water for farming at minimal cost, and (ii) be installed with minimum impact on our land. Specifically, the Project will explore how water catchment systems can be designed and installed below the PV-array, as well as paired with rain-barrels at the end of rows to provide efficient, low-cost access to water. This will improve the efficiency of our farming operation, create financial savings, and give the project team opportunities to test out proof-of-concept ideas that can enhance the farming component of dual-use projects. As far as land impacts, the racking canopy foundations will be designed and installed per the performance guidelines of the Ag-Energy RFR. Specifically, the canopies will be supported by driven piles without footings, and there will be no grading or stripping of soils. We also intend to remove and recycle the PV-array once it has reached the end of its 20- to 30-year lifecycle, and are likely to restore and/or maintain the land to preserve its agricultural use.

Expand Research Typology Frameworks and Data - (i) Compare between the relative productivity of non-dual use agricultural operations (i.e. non-solar test plots) and operations within a “Dual-Use” project; (ii) Creation of an assessment tool that enables basic business planning for Dual-Use projects. This tool, captured in the Final Report outlined in the RFR, will offer an integrated view of the combined yields per acre (i.e. food and electricity) as influenced by the following factors:

| | |
|----------------------------------|--|
| PV-Geometry and spacing | Permaculture strategies |
| PV-project size | O&M practices |
| Size of respective growing zones | Projected revenues vs. actual revenues |
| Crop choice | Projected costs vs. actual costs |

Raise Awareness of Dual-Use and its Replicability – (i) Demonstrate that the proposed design, scale, and business strategy is a model that can be replicated in different contexts in Massachusetts and beyond (e.g. urban, rural, large-scale, small-scale); (ii) Develop future partnerships with industry organizations not listed as part of the present project team to raise awareness of Dual-Use and its potential (e.g. Urban Farming Institute, Massachusetts Wildflower Society, Northeast Organic Farming Association, organizations supporting traditional growing and livestock grazing, etc.); (iii) Engage BlueWave to implement online marketing campaign (e.g. photos, video, blog entries) that raises awareness of Dual-Use with the general public.